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RURAL ELECTRIC RESEARCH

by

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Twenty years ago there was no such term as Rural Electrification Research. In fact, it is within the memory of many of us here that Rural Electrification had its beginning.

Were I, now, to attempt a complete picture of all the research in the applications of electricity in agriculture and agricultural enterprises I would have to prepare, not a paper, but a book. Five pages would be required to name the applications, some of which would require several pages for discussion.

Not all of the 250 or so applications have been the subject of special study and observation, nor have all those that have been studied been thoroughly investigated. Neither have the so-called rural electrification investigators been responsible for all of the research in their field. There is a host of investigators in other fields of agriculture who because of necessity have been forced to use electricity in some way. These men have contributed much to our store of knowledge and have added many items to the list.

Since the physicist and chemist have opened their "bags of tricks" to the general public they no longer mystify the other professions and unless engineers familiarize themselves with other sciences, primarily biology, they are going to see the ball travel toward the goal but somebody else will be carrying it. Pastures may look greener on the other side of the fence, but the green on our side shows up pretty well to the other fellow too, and when he has helped clean up our field we had better be able to jump into his field with him when he goes back. We must know something besides engineering if we are going to add much to present knowledge. There are many applications of electricity which may become important in a load-building program once they are dug out of the mass of literature published by the biologist who includes references to its use merely as a means to his end. We must not only be able to read his reports but we must be sufficiently interested to do so.

Obviously it would be impossible for any one person or even a small group of people to find references to all such applications, but we can occasionally get together with these scientists and find out what they are doing and how they are using electricity.

A few months ago, when the Division of Rural Electrification Research was organized, one of its first acts was to borrow from some of the colleges and universities men who have had considerable experience in rural electrification and its problems and send them to visit departments of agricultural engineering, dairying and poultry husbandry in thirty-seven states. Specialists in these departments were called together and discussed all of the various uses of electricity in their several fields.

Each of these men sent or brought to Washington a report of his findings. I want to summarize very briefly their reports, but first let me tell you what was sought in the surveys and why. The men met with extension specialists as well as research workers and although their mission was primarily to gather data and reports on research, both active and completed, they did ask what recommendations were being made and how these recommendations are being accepted and adopted. Any statement in regard to how they are being accepted and adopted was, of course, considered as opinion because we could not expect the men to have definite figures on many of the points raised.

The seven men who collected the information were hired for a survey of either poultry or dairy research, but the men who visited the southern states and the Pacific Coast states included both dairy and poultry as well as other applications in their surveys. With the exception of some of the North Atlantic and New England stations were not visited twice, so that when I say 37 states were visited I do not mean that complete information on research in rural electrification in each of these states was obtained.

One of the first things discovered was the large number of cases in which two men at an institution differed in their thought and recommendations on a given subject. On the whole, however, there was unification of opinion within the institution.

The following summary shows briefly what research has been done or is still active:

Poultry:

Much information was gathered on types and construction of buildings, but since we are for the time interested only in electrification we shall omit any except necessary reference to structures.

Ventilation: The subject of ventilation is closely associated with structures, but with the adoption of forced ventilation in barns, stables and other buildings, it seems necessary for the rural electrification specialist to interest himself in it. Although no research in poultry house ventilation was reported, it is known that some has been done. Studies so far have mostly been done on natural-draught ventilation. Since this paper is written for the purpose of summarizing the results of the survey only, no discussion is given of the relative merits of the various systems of ventilation, but sooner or later something definite will be done about it.

House heating: A little research has been conducted in the heating of laying houses. Results so far generally indicate that if the house is properly insulated and so designed that it may be closed to eliminate the danger of freezing or draughts, there is little need for heating. It has been found that for optimum results temperatures between 20° and 40° F. are best for egg production. Egg sizes begin to decrease at temperatures above 40° F. Keeping in mind the fact that freezing occurs at 32° F. it would seem from these statements that the optimum temperature for holding a laying house would be between 32° and 40° F. It is only recently that engineers and poultry specialists have been bold enough to recommend brooding in an unheated room. Warming the house probably has little influence upon the condition of the litter. Several experiment stations have been working on the litter problem, but the solution does not seem to be in heating the house.

Brooding: Brooding experiments have been conducted all over the country. Few of the experiments have been of a fundamental nature, however, and as a result we still have some questions on brooding.

One of the outstanding problems is that of maintaining a dry litter under the hover. Some experiments indicate that damp litter is not necessarily a detriment to the development of chicks and that the greatest objection to wet litter is that it forms a breeding ground, or at least becomes a harbor for organisms that cause disorders in the chicks. It has been suggested that the psychology of the poultryman is also a factor.

We know very little about the conditions of air under hovers requisite to most satisfactory development. Should the air be dried before forcing it into the brooder? How much new air should be introduced into the brooder per unit of time at various ages of chicks? How much does any one factor depend upon or influence the others?

Lighting: Some studies have been made of the effects of light upon the production of laying hens, but there still remains the big problem of proving that supplemental light does what is often claimed for it. Probably the reasons such studies have not been made are that the results seem obvious and poultrymen are satisfied, and that a research project on the effects of light upon production is expensive. Those few and limited attempts at studying the real effect have left us with problems of a deeper nature than was at first thought. To some research workers it looks as if light may stimulate the reproductive organs and in this way cause the hen to lay more, or when the poultryman wishes, and that she eats more because she must, instead of her being forced to lay because she will eat as long as there is food and she can see to eat.

Feed Grinding and Mixing: A few states have made tests on grinding feed for birds as well as for stock, and while it seems to be an economical thing to do, especially on the farm that can produce its own feed, not much of it is being done. Uniformity of product has been found a desirable thing and since the egg, particularly the

yolk color, is readily affected by the ration, it seems essential that a certain degree of uniformity in feed mixes be used. This is especially true of poultry cooperatives where large numbers of eggs are handled in single shipments. The quality of eggs reaching eastern markets from Pacific Coast points are sufficient evidence. For this reason cooperatives have found it preferable to have a few establishments do the grinding and mixing according to formulas which have been found by experience to be best for the given community. Since these "co-ops" will often sell feed to outsiders, the outsiders have become accustomed to using poultry rations already mixed. Then, too, there is a convenience associated with opening a sack of feed already prepared over opening several sacks of grain, grit, bone, fish meal and what not, and mixing them. Some ingredients must be bought anyway, so why not buy it all?

Refrigeration: The production of eggs runs well over a 100,000,000 dozen a year. It is a quite well established fact now that eggs should be cooled within a few hours after they are laid if the best quality may be expected. Reducing the temperature alone is not sufficient. The relative humidity of the air must be high. Eggs are susceptible to flavor contamination the same as most other foods. It is essential, therefore, that the storage be used for nothing else. The problem may be solved in the western part of the United States, where the air is normally dry in warm weather, by means of evaporative cooling. The air must pass through the evaporator over the eggs and out of the room. Both cooling and humidification are accomplished in this way. The air may not be recirculated, even though that may be a means of increasing the moisture content, because the heat is still in the air, although its temperature has been reduced in its first passage through the evaporator. In humid states it may be necessary to resort to mechanical refrigeration.

If slaughtering is done on the farm it would seem that mechanical refrigeration could be used profitably, especially if it is more convenient for the farmer to slaughter some time before marketing. Reports of interviews submitted by the surveyors did not indicate that a great deal of slaughtering is being done on the farms or if it is, that refrigeration is being employed.

These brief statements concerning the poultry survey have by no means exhausted the data. There was much significant information in the reports which we hope may, at least in part, be made available to you some time. Interesting as are the applications of electricity in the poultry industry, I should like to tell you something of the dairy survey also.

Dairy:

Barn Lighting: The one interesting thing about the lighting of dairy barns, in fact, the lighting of all farm buildings aside from the home, is that at least eight states are making recommendations, while only two have done any research, and their studies have been mostly in the use of ultra-violet radiation. Nobody knows just

how much light is best for the dairy barn. We assume that it should be sufficient to enable the worker to move about and perform his regular tasks efficiently. Is that all, we may ask? What effect has light on the cow? Would a soothing light encourage her to yield her milk more willingly? What kind of light is soothing to a cow? What, if any, physiological effect does it have?

Wiring: Types of wiring are also recommended without a research background. Several stations have made observations, but no formal research project has been set up by any of the stations visited as revealed by the survey. One of the interesting things about wiring in particular is that nearly all of the stations are agreed that "B.X." or flexible metal-covered cables should be eliminated from farm building wiring. There is a sympathetic feeling toward those who advocate non-metallic sheathed cable.

Water Systems: No definite research on water systems was reported, although many states reported an extensive use of running water with drinking cups in the barns. Only three, so far as our survey has been tabulated, have shown any hesitancy about recommending drinking cups, and those do not recommend them because of the possibility of freezing. The cost is rather high for small dairies and especially so when one cup is provided for each cow. Some states recommend one cup for each two cows; while others believe that this practice is conductive to the spread of diseases.

Milking Machine: One application about which there is a great deal of controversy is the milking machine. The milking machine is used in practically all of the northern and in many of the southern states visited. The principal objection to the milking machine seems to be that it is unsanitary, not so much in itself, but that it is frequently improperly cleaned and sterilized. Some men hold to the idea that it is responsible for the spread of mastitis, and that if it is used, it must be used under good supervision.

Dairymen have a variety of ideas as to the size of dairy herds necessary for profitable use of a milking machine. The lowest number of cows suggested was eight to ten; while the highest lower limit given was thirty. The majority of those giving an opinion on this matter gave fifteen. Portable milkers may be considered as temporary appliances and in most dairies, where milking machines become a part of the regular dairy equipment, pipeline types are installed. Studies made on the energy requirements of milking machines revealed that 2.93 kwh of electrical energy were used per thousand pounds of milk drawn when the herd consisted of an average of 38.7 cows. In another test of five herds averaging 35 cows each the energy consumption was 2.56 kwh per cow per month, or 4.5 kwh per thousand pounds of milk.

Feed Grinding and Mixing: Reports of the grinding and mixing of feeds showed that few states recommend these practices on the farm and that they are really not being followed very generally. Three states have had definite research projects on the problem. In

New England, both home grinding and custom grinding by traveling grinders are going out. Where mixing is done the majority of it is done on the barn floor with a shovel. Farmers don't see the advantage of grinding unless the grain is ground fine, and as a result home grinding is very frequently done too fine. Some states believe there is room for a lot of study on all kinds of feed preparation.

Silo Filling: The use of silage is widespread, but here, too, we see a shift from corn and other materials commonly used for silage to grass silage. The part that the cutting of grass silage will have on the use of electrical power is problematical. The tendency is to recommend the use of all-crop machines which chop, crush, or grind the material as it is cut in the field and load it on to wagons, ready for elevating to the silo. Should this practice become popular, then a small motor with a drag-type elevator or similar device would be satisfactory for filling the silo, and would probably be used to a considerable extent, because the tractor would be busy in the field. At the present time jobs as heavy as silo filling are done mostly with tractors.

One dairy husbandman believes that we are passing through a revolutionary process in trying to preserve hay crops. Drying, making silage of grass, chopping hay and so on, are but stages in this revolutionary process. There is also need for more knowledge on the handling of molasses.

Hay Chopping: Hay chopping seems to be losing out in some of the states. The greatest advantage in using chopped hay seems to be from the handling standpoint. It does increase consumption according to the belief of some. The practice of cutting may be justified in the case of high-priced hay or where hay is very scarce as during droughts. One of the principal difficulties associated with the chopping of hay is getting rid of pieces of wire and nails, the cause of considerable loss to dairymen. This is a real problem, as expressed by several states. Harrison, of New York, believes that the chopping of hay makes it less palatable, especially timothy. He also comments that a cow has teeth for chewing and lots of time to chew.

Pasture Irrigation: Pasture irrigation is another application of considerable interest to me. Very few of the states visited had anything to say about it. However, four of them have actually done some research and believe it may be practiced profitably in certain areas. Wisconsin doubled production even in a year of average rainfall. Illinois believes that pasture irrigation has considerable possibilities.

Milk Cooling and Refrigeration: I think more dairy husbandmen and agricultural engineers expressed their opinion on refrigeration than on any other application of electricity in the dairy industry. The trend in refrigeration is towards commercial units and away from concrete tanks. In the Southern States sixty to eighty-five per cent of farmers having electricity use some type of mechanical refrigeration. Most of the states recommend wet storage. Wholesalers general-

ly use wet storage, while producer-distributors use aerators and dry, walk-in storages.

Not many direct-expansion aerators are used, but there seems to be some shift toward them. Aerators are used principally by producer-distributors and have a very definite place in the cooling of morning milk. An interesting fact about ordinances with respect to the use of aerators is than even neighboring communities may require or prohibit the use of aerators. This fact leads extension specialists and dairymen to wonder if there are not still sufficient problems involved to justify research. This is true not only of aerators but of the efficiency of cooling tanks with agitators, lengths of coils and so on. Arguments are presented to justify the use of many kinds of equipment. It is difficult sometimes for us to sort out the points that really are facts determined by experiment, from those that are statements designed to aid in making sales.

Records in one state show an energy consumption of 1.18 kwh per hundred pounds of milk in wet storage, and 2.5 kwh per hundred pounds of milk when both aerators and dry storage were used. Milk cooled over aerators and sold directly required 0.68 kwh per hundred pounds. No data seem to have been presented which show advantages of brine over "sweet water" or vice versa. Which one is used probably depends largely on the aggressiveness of some salesman.

As previously stated, most dairymen opened their hearts on this subject, and with your permission I should like to quote some of them without mentioning their names: "The cooling of milk does not improve the quality but merely aids in retaining it." "If quality milk is not produced no amount of refrigeration will improve it." Another statement that was made may be open to challenge, and that is, "Farmers produce quality milk to avoid punishment." The statement is also made that "the premium basis is not a satisfactory method of encouraging farmers to produce high quality milk. It sets up a standard only for a trade area." This same gentleman makes the statement that "aerators are the cheese factories of the farm," inferring, of course, that these devices are usually not properly washed.

Water Heaters and Sterilizers: Water heaters and sterilizers are usually spoken of as load builders. They, are, however, not used extensively and not universally recommended by the extension specialists of the various states visited. Many of the men expressed the opinion that there is great need for a practical, low-priced sterilizing unit. There is still some question, however, as to the best method of sterilizing. Some states require chemical sterilization. In many parts of the country steam is relied upon for this purpose. Some work is being done with the "sterile" lamp. Regardless of how sterilizing is done, there has been an expression of desire for having it done quickly and easily. There is not much difference north, south, east or west in the sterilizing situation. In some states household types of water heaters are used for furnishing hot water to the dairy, but in most of the larger dairies steam boilers are used for this purpose. One problem that was mentioned more than any other

is the need for a heat-resistant rubber that will stand the heat of sterilization. This problem could probably best be worked out in cooperation with one of the concerns manufacturing rubber tubing.

In concluding these brief remarks I should like to point out the fact that poultrymen do not object to giving electricity credit for what it does for them, but they feel that good management plays a very important part in successful poultry farming. Many of them think that through selective breeding, timing of hatches and proper feeding they can exercise all the control over laying necessary or desired. It is up to us as rural electrification engineers to find out whether or not it can be done cheaper or more effectively by the use of electricity.

Convenient and efficient as electricity may be on the farm, interested as farmers have been in having it available, and even with one-fifth of the farms in America electrified, it must prove its superiority and keep on proving it, if its use outside the home is to be extended. Many years are required for the acceptance of new ideas and the adoption of new methods. Naturally, there is resistance to the purchase and use of new equipment that requires changes in practice, but by everlasting research and eternal hammering on new but proven ideas we may someday see our dreams of an electrified rural America come true.

This fleeting glance at the picture may lead one to wonder if electrification of farms and rural communities may not be a hopeless venture. Such is not at all the case. We have been taking the job seriously for only about fifteen years, and reaching a fifth of the farms of the country with a program that requires an average expenditure of around $750.00 each represents no small progress. If acceptance has appeared show in the dairy and poultry enterprises, what must it be in others? Even this question should not trouble us too much. Suppose farmers had gullibly accepted all of the devices and gadgets as they appeared on the sales floor, what then? It seems to me that a substantially better program has been started by virtue of the fact that farmers have been reluctant to purchase equipment until it has been proven to be of economic value. It is our job as agricultural engineers to find ways and means for him to use electricity to produce more efficiently those things that he has to sell, and in doing this we must not overlook the low income farmer. It is his problem that offers the greatest challenge.